99. FOODS AND BEVERAGES
90
426-20
1923
RECORDED

PATENT SPECIFICATION

Convention Date (United States): Oct. 3, 1921. **186,923**

Application Date (in United Kingdom): Oct. 3, 1922. No. 26,750/22.

Complete Accepted: June 14, 1923.

Fungus on Rice

COMPLETE SPECIFICATION.

Improvements in the Manufacture of Leavened Bread.

We, WARD BAKING COMPANY, a corporation organised under the laws of the State of New York, United States of America, of Southern Boulevard and 143rd Street, Borough of Bronx, City of New York, County of Bronx and State of New York, United States of America, Assignees of HENRY ADOLPH KOHMAN, ROY IRVIN and ERNEST SALATHIAL STATELER, all citizens of the United States of America, and all of Mellon Institute of Industrial Research, University of Pittsburg, Pittsburg, Pennsylvania, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

In the Specification of Letters Patent No. 156,635, are described certain new and useful improvements in the manufacture of leavened bread, wherein by the addition of certain diastatic and proteolytic enzymes produced by the growth of aspergillus oryzæ upon suitable carbohydrates and protein substances it is possible to effect an extraordinary economy in the amount of yeast normally employed in the bread making operation, and also to lessen materially the quantity of sugar usually added in making up the dough batch.

In the preferred practice of the invention as set forth in the patent referred to, the enzymes are produced by the growth of the aspergillus oryzæ upon coarse hominy, that is to say, Indian corn or maize, which has been decorticated and deprived of its oily germ, and coarsely cracked, say into halves. The hominy grains are then caused to absorb a quantity of water so as to soften and swell them, in the manner set forth in detail in the specification of the patent referred to, and the seeding stock, obtained by cultivating the aspergillus oryzae upon some suitable medium, as for instance, upon slices of bread, is then used to inoculate the particles of hominy, the process of incubation being proceeded with until the mycelium of the fungus growth has spread throughout the mass of hominy and until the whole mass, in layer form, has been bound together into a cake-like body. This cake is thereafter dried and ground up to a fine powder, under conditions set forth at length in the specification of the patent referred to. The fine powder or meal thus obtained may then be employed in suitable proportion in making up the dough batch, or the enzymes, being soluble, may be dissolved out of the cake either before or after grinding, and the solution thus obtained may be used instead of the meal. The specification of the patent likewise gives directions for the utilization of the enzyme product in the making of leavened bread, both by the direct process and by the sponge process.

We have now discovered that by the employment of the fungus mucor rouxii, it is possible to obtain an enzyme product which, when used in the manufacture of leavened bread, is particularly strong in those properties which tend to stimulate the yeast and mature the gluten of the dough batch, so that the use of a smaller quantity of the product of the present invention (either in meal form, or as an extract) will result not only in a satisfactory saving in sugar by reason of the diastatic action of the enzyme product upon the starch of the dough batch, but also in an adequate stimulation of the fermentation (with a consequent saving of yeast employed) and maturing of the gluten of the dough batch by the action of the proteolytic enzymes present. Furthermore, the employment of the enzyme product obtained from the mucor

[*Price* 1/-]

20

rouxii, in the manufacture of leavened bread is found to result in an improvement in the color and in the texture of the finished loaf.

In practice, we prefer to grow the mucor rouxii fungus upon rice, either polished or unpolished. The rice grains are caused to absorb a quantity of water sufficient to soften and swell them to say twice or more than twice their size. This is conveniently effected by bringing the water employed to a boiling temperature and stirring into it the rice, in proportions which are preferably about 100 parts, by weight, of rice, to 75 parts, by weight, of water.

The rice may be added gradually, or all at once, and the water is kept hot, and the cooking operation continued until the water has been sufficiently absorbed to cause the rice particles to become soft and to swell, as described, and nevertheless to present a fairly dry appearance. It is preferred to carry on the cooking operation in an open vessel rather than in an autoclave and under pressure, for the reason that, if cooked with pressure, the subsequent action of the enzyme product upon the rice is to convert a larger proportion of it into sugar than would otherwise be the case, the excess of sugar, in such instance, causing the material to stick to the grinding apparatus to a greater or less degree, and making it more difficult to reduce the material to a fine meal or powder.

After the cooking operation, the rice is permitted to cool to a temperature about 35° C., and will retain its identity as individual water-swollen grains or particles. These water swollen particles are then subjected to the action of a seeding stock obtained from mucor rouxii. The seeding stock is in the form of a dry powder and is intimately mixed with the particles of rice so as to come as thoroughly in contact therewith throughout the mass as possible. This seeding stock, in the preferred practice of the invention, is obtained by cultivating the mucor rouxii on cooked rice having a moisture content of about 75% on the weight of the rice, the rice undergoing inoculation being maintained in a moist atmosphere. The mucor rouxii readily grows upon this medium and a mycelium forms in threads which extend as a thick coat over the rice and in and between the individual particles. The rice with the mycelium thereon is then dried slowly and the drying material ultimately begins to take on a more or less dark color due to the formation of spores throughout the entire mass. When the mass has been dried to such a degree that it can be converted into a dry powder, it is pulverized accordingly and constitutes the dry seeding stock.

As above noted, this seeding stock is employed for the inoculation of the water swollen particles of rice employed as the growing medium. The mixture of the seeding stock with the body of rice presents externally a fairly dry appearance and is in such physical condition that it may be spread out on trays, in layers say 1″ to 3″ in thickness with interstitial air spaces between the individual particles. The trays may conveniently consist of galvanized iron frames having galvanized iron screen bottoms, and the trays may be slipped into a rack one above the other. In those instances where it is desired to obtain an enzyme product which is to be extracted with water, it is not important that the growth of the spores be restricted, and in such case, provision is made for free access of the air both to the top and bottom of each of the individual trays so that there may be an ample circulation of air over, below and through the entire mass, thereby correspondingly stimulating the growth of the fungus and incidentally stimulating the production of the spores, which, as above noted, are of a dark color. The color of the spores we have found is not extracted when water is employed for extracting the enzymes from the cake; so that it is possible to have a water solution of the enzymes without introducing therein any material coloring matter from the dark spores. On the other hand, when the dried cake is to be ground up into a meal-like powder, the production of spores should be restricted materially, and this may be effected by correspondingly restricting the aeration of the rice undergoing incubation; as, for instance, by spreading the layers of material upon trays having an imperforate bottom and so arranged that the bottom of each of the superposed trays of a series shall serve as a cover for the tray beneath, with the exception of a marginal space of about $\frac{1}{4}$ of an inch. This marginal space being in communication with the air will permit a growth of the mycelium amply sufficient to bind the particles into a coherent cake or mass, while at the same time diminishing the tendency of the fungus to sporulate.

In those instances where the enzymes are to be extracted by water, and where, consequently, free aeration of the mass during the process of incubation is practiced, the freely ventilated trays containing the layers of water-swollen rice with which the seeding stock has been intermingled, as described, are now placed in

a room which is kept at a temperature ranging from 25° C. to 40° C. (preferably about 35° C.), and the fungus is allowed to grow for a period of say 1½ to 3 days. The atmosphere of the room is kept moist by injecting water vapor into the room in the form of steam or humidified air so as to prevent the surface of the batch from drying up, which would interfere with the growth of the fungus. The fungus is permitted to grow, as described, from 1½ to 3 days until the mycelium has spread throughout the whole mass, binding it all together in a cake-like body.

In those instances wherein the admission of air to the batch is restricted during the incubating operation the same provisions as to temperature of incubation are to be observed, but a somewhat greater length of time will be required for the growth of the fungus in order to obtain the desired binding together of the mass by the mycelium into a cake-like body. So also, in such cases, it will usually be unnecessary to inject watery vapor or humidified air into the incubating room, for the reason that the tendency for the surface of the batch to dry up is very materially lessened.

The cake, whether produced by the free ventilation or the restricted ventilation described, is then dried, either by atmospheric air, or by the application of heat and ventilation, or by means of a vacuum and heat. In the drying operation it is preferred not to raise the temperature above about 70° C., for the reason that a higher temperature tends to weaken the enzymes, and for the further reason that the product darkens if heated to too high a degree, which is objectionable because it makes the product less attractive, and would also darken the bread in which it is intended to incorporate the product.

The enzymes being soluble may be dissolved out of the cake-like mass either before or after drying, and the solution thus obtained (either with or without concentration) may be employed in making up the dough batch. Where the dried cake is not materially colored by the presence of spores, it will be preferable, however, to grind it to a fine powder, constituting meal, the grinding being preferably carried to such a degree that the meal will pass through a screen of from 100 to 200 mesh to the linear inch, this fine grinding being desirable so that the particles may be approximately the size of flour so that they may not be perceptible as such in the crust of the baked bread.

The fine meal, as thus obtained, may be employed as such in making up the dough batch and in the proportion of ½ lb. to 2 lbs. for 1000 lbs. of flour used; or the enzymes dissolved out of the cake may be used instead of the meal. In either event, there will be present, either in the meal or in the solution, a quantity of sugar produced by the action of the diastatic enzymes upon the starch of the rice, and this sugar will be available in the bread making operation by contributing to make up the normal amount of sugar required for the bread.

Instead of using the extract, however, it is preferred to use the ground meal, for the reason that, in the dry condition, the cake and the meal obtained therefrom are not subject to fermentation or deterioration to any marked degree, even though stored for a long period of time, and may be conveniently packed and transported for convenient commercial use without the use of any preservative agents, whereas, in the absence of such preservatives, solutions are apt to ferment and sour.

In the so-called direct process of making leavened bread, about ½ lb. to 2 lbs. of the meal-like product are incorporated with 1000 lbs. of flour to which has been added the ordinary additional ingredients of the dough batch, such as milk, sugar, salt, shortening and yeast. It is found, however, that the employment of this amount of the meal-like product effects the saving of a large quantity of the sugar that is ordinarily required, and, in spite of the fact that the amount of the product employed is much less than that of the aspergillus maize product of the patent referred to, there is a saving of about 30 to 40% of the normal output of yeast employed for a given period of fermentation—that is to say, a saving of yeast of about the same amount as is incident to the use of the aspergillus maize product of the patent. Consequently in making up the dough batch the sugar and yeast may be correspondingly diminished.

In the so-called sponge process of making leavened bread, the meal-like product is added, in the sponge stage of the operation, to the flour, water and yeast, the quantity of yeast employed being but 60% to 70% of that normally used. So also in the second stage of the operation, the dough batch is made up in the usual way with the exception that the amount of sugar normally required is materially reduced.

In the practice of the present invention we have found that rice has given us the best results as the medium upon which the mucor rouxii is to be grown. It will be understood, however, that we do not restrict ourselves to employing

rice as the growing medium, but may employ either in admixture therewith or in substitution therefor other appropriate carbohydrates and protein substances.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. The method of making leavened bread, which comprises bringing into admixture with the flour, yeast and other ingredients of the dough batch, diastatic and proteolytic enzymes produced by the growth of mucor rouxii upon carbohydrate and protein substances, and fermenting the batch; substantially as described.

2. The method of making leavened bread, which comprises bringing into admixture with the flour, yeast and other ingredients of the dough batch, a meal-like product containing diastatic and proteolytic enzymes produced by the growth of mucor rouxii upon carbohydrate and protein substances, and fermenting the batch; substantially as described.

3. The method of making leavened bread, which comprises bringing into admixture with the flour, yeast and other ingredients of the dough batch, diastatic and proteolytic enzymes produced by the growth of mucor rouxii upon rice and fermenting the batch; substantially as described.

4. The method of making leavened bread, which comprises bringing into admixture with the flour, yeast and other ingredients of the dough batch, a meal-like product obtained by grinding up a dried cake consisting of carbohydrate and protein substances containing diastatic and proteolytic enzymes produced by the growth of mucor rouxii thereon, and fermenting the batch; substantially as described.

5. The method of making leavened bread, which comprises bringing into admixture with the flour, yeast and other ingredients of the dough-batch, a meal-like product obtained by grinding up a dried cake consisting of rice, containing diastatic and proteolytic enzymes produced by the growth of mucor rouxii thereon, and fermenting the batch; substantially as described.

Dated this 3rd day of October, 1922.

CRUIKSHANK & FAIRWEATHER,
65—66, Chancery Lane, London, W.C. 2,
and
62, St. Vincent Street, Glasgow,
Agents for the Applicants.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1923.